Electronic Version
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Claims

[c1] A method comprising:
providing a semiconductor alloy layer on a semiconductor substrate;
forming a gate structure on the semiconductor alloy layer;
forming source and drain regions in the semiconductor substrate on both sides of the gate structure;
removing at least a portion of the semiconductor alloy layer overlying the source and drain regions; and
forming a metal silicide region over the source and drain regions.

[c2] The method of claim 1 wherein removing at least a portion of the semiconductor alloy layer comprises etching the semiconductor alloy layer.

[c3] The method of claim 1 wherein removing at least a portion of the semiconductor alloy layer comprises exposing the semiconductor alloy layer to an etchant for a period of time until the semiconductor alloy layer overlying the source and drain regions is fully removed.

[c4] The method of claim 3 wherein forming a metal silicide

region comprises forming a metal silicide region having a metal selected from the group consisting of cobalt and titanium.

[c5] The method of claim 1 wherein removing at least a portion of the semiconductor alloy layer comprises using an anisotropic reactive ion etch to remove at least a portion of the semiconductor alloy layer.

[c6] The method of claim 1 wherein removing at least a portion of the semiconductor alloy layer comprises:
altering at least a portion of the semiconductor alloy layer to a material receptive to a selective removal process; and
selectively removing the altered semiconductor alloy layer from overlying the source and drain regions.

[c7] The method of claim 1 wherein removing at least a portion of the semiconductor alloy layer comprises:
oxidizing at least a portion of the semiconductor alloy layer to form a silicon oxide material receptive to a selective wet etch process; and
selectively removing the altered semiconductor alloy layer from overlying the source and drain regions.

[c8] The method of claim 1 wherein removing at least a portion of the semiconductor alloy layer comprises:

oxidizing at least a portion of the semiconductor alloy layer to form a silicon oxide material receptive to a selective dry etch process; and
selectively removing the altered semiconductor alloy layer from overlying the source and drain regions.

[c9] The method of claim 1 wherein removing at least a portion of the semiconductor alloy layer comprises:
consuming at least a portion of the semiconductor alloy layer to form a metal silicide material receptive to a selective wet etch process; and
selectively removing the altered semiconductor alloy layer from overlying the source and drain regions.

[c10] The method of claim 1 wherein removing at least a portion of the semiconductor alloy layer comprises:
consuming at least a portion of the semiconductor alloy layer to form a metal silicide material receptive to a selective dry etch process; and
selectively removing the altered semiconductor alloy layer from overlying the source and drain regions.

[c11] The method of claim 1 wherein removing at least a portion of the semiconductor alloy layer comprises:
forming a metal layer over the semiconductor alloy layer overlying the source and drain regions;
annealing the metal layer and the semiconductor alloy

layer and forming a metal silicide material; and
selectively etching the metal silicide material.

[c12] The method of claim 1 wherein removing at least a portion of the semiconductor alloy layer comprises:
forming a metal layer over the semiconductor alloy layer overlying the source and drain regions;
annealing the metal layer and the semiconductor alloy layer and forming a disposable metal silicide material;
selectively etching the disposable metal silicide material overlying the source and drain regions;
forming a second metal layer; and
annealing the second metal layer and forming a second metal silicide material.

[c13] The method of claim 1 wherein removing at least a portion of the semiconductor alloy layer comprises:
forming a metal layer over the semiconductor alloy layer overlying the source and drain regions;
annealing the metal layer and the semiconductor alloy layer and forming a metal-semiconductor alloy layer overlying the source and drain regions;
implanting ions of at least one predetermined species into at least a portion of the metal-semiconductor alloy layer; and
annealing the metal-semiconductor alloy layer and forming a metal silicide material.

[c14] The method of claim 1 wherein removing at least a portion of the semiconductor alloy layer comprises:
forming a metal layer over the semiconductor alloy layer overlying the source and drain regions;
implanting ions of at least one predetermined species into at least a portion of the metal layer;
annealing the metal layer and forming a metal-semiconductor alloy layer overlying the source and drain regions; and
annealing the metal-semiconductor alloy layer and forming a metal silicide material overlying the source and drain regions.

[c15] The method of claim 1 wherein the semiconductor alloy layer comprises SiGe.

[c16] The method of claim 11 wherein anneal the metal layer comprises performing a rapid thermal anneal process.

[c17] A method of forming a semiconductor device, comprising:
forming a gate structure on a semiconductor alloy layer in a semiconductor substrate;
forming source and drain regions in the semiconductor substrate on both sides of the gate structure;
altering at least a portion of the semiconductor alloy

layer overlying the source and drain regions; and removing, at least partially, the altered semiconductor alloy layer overlying the source and drain regions.

[c18] The method of claim 17, further comprising forming a metal silicide layer over the source and drain regions.

[c19] The method of claim 17 wherein removing the altered semiconductor alloy layer comprises etching the semiconductor alloy layer.

[c20] The method of claim 17 wherein removing the altered semiconductor alloy layer comprises exposing the altered semiconductor alloy layer to an etchant for a period of time until the semiconductor alloy layer overlying the source and drain regions is fully removed.

[c21] The method of claim 18 wherein forming a metal silicide region comprises forming a metal silicide region having a metal selected from the group consisting of cobalt and titanium.

[c22] The method of claim 17 wherein removing the altered semiconductor alloy layer comprises using an anisotropic reactive ion etch to remove at least a portion of the altered semiconductor alloy layer.

[c23] The method of claim 17 wherein altering and removing

at least a portion of the semiconductor alloy layer comprises:

oxidizing at least a portion of the semiconductor alloy layer to form a silicon oxide material receptive to a selective etch process; and

selectively removing the altered semiconductor alloy layer from overlying the source and drain regions.

[c24] The method of claim 17 wherein altering and removing at least a portion of the semiconductor alloy layer comprises:

consuming at least a portion of the semiconductor alloy layer to form a metal silicide material receptive to a selective etch process; and

selectively removing the altered semiconductor alloy layer from overlying the source and drain regions.

[c25] The method of claim 17 wherein altering and removing at least a portion of the semiconductor alloy layer comprises:

forming a metal layer over the semiconductor alloy layer overlying the source and drain regions;

annealing the metal layer and the semiconductor alloy layer and forming a metal silicide material; and

selectively etching the metal silicide material.

[c26] The method of claim 17 wherein altering and removing

at least a portion of the semiconductor alloy layer comprises:

forming a metal layer over the semiconductor alloy layer overlying the source and drain regions;

annealing the metal layer and the semiconductor alloy layer and forming a disposable metal silicide material;

selectively etching the disposable metal silicide material overlying the source and drain regions;

forming a second metal layer; and

annealing the second metal layer and forming a second metal silicide material.

[c27] The method of claim 17 wherein altering and removing at least a portion of the semiconductor alloy layer comprises:

forming a metal layer over the semiconductor alloy layer overlying the source and drain regions;

annealing the metal layer and the semiconductor alloy layer and forming a metal-semiconductor alloy layer overlying the source and drain regions;

implanting ions of at least one predetermined species into at least a portion of the metal-semiconductor alloy layer; and

annealing the metal-semiconductor alloy layer and forming a metal silicide material.

[c28] The method of claim 17 wherein altering and removing at least a portion of the semiconductor alloy layer comprises:
forming a metal layer over the semiconductor alloy layer overlying the source and drain regions;
implanting ions of at least one predetermined species into at least a portion of the metal layer;
annealing the metal layer and forming a metal-semiconductor alloy layer overlying the source and drain regions; and
annealing the metal-semiconductor alloy layer and forming a metal silicide material overlying the source and drain regions.

[c29] The method of claim 17 wherein the semiconductor alloy layer comprises SiGe.

[c30] A semiconductor device comprising:
a substrate;
a gate structure formed over the semiconductor alloy layer;
source and drain regions formed on both sides of the gate structure in the substrate; and
a semiconductor alloy layer in the substrate below the gate structure but absent from the source and drain regions.

[c31] The semiconductor device of claim 30, wherein the semiconductor alloy layer comprises SiGe.

[c32] The semiconductor device of claim 30, further comprising a metal silicide layer over the source and drain regions

[c33] The semiconductor device of claim 30, further comprising a partial layer of semiconductor alloy layer in the substrate overlying the source and drain regions.